



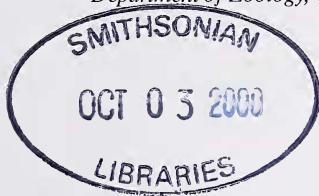
## ***Thyroptera discifera* (Chiroptera: Thyropteridae): A new record for Costa Rica and observations on echolocation**

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### **Abstract**

We report the first record of the disk-winged bat *Thyroptera discifera* (Chiroptera: Thyropteridae) found in Costa Rica and present observations on morphology and echolocation behavior of this poorly known species. Diet analysis showed the presence of Lepidoptera scales and spider fragments in the bat's feces. Echolocation calls showed very low intensity and consisted of several frequency-modulated harmonics. Behavior and echolocation calls, together with data from fecal samples, suggest a gleaning insectivore lifestyle for the species.

**Key words:** *Thyroptera discifera*, Thyropteridae, Costa Rica, echolocation, spider

### **Introduction**

The bat family Thyropteridae, disk-winged bats, is endemic to the neotropics. The characteristic suction caps at the base of thumbs and ankles are an adaptation to their roosting habits, and permit the animals to cling to smooth surfaces of plant leaves during the day (SCHLIEMANN 1971). Three species currently are recognized, all in the genus *Thyroptera*. *Thyroptera tricolor* Spix, 1823 is the most widely distributed species and ranges from Veracruz to Brazil (WILSON and FINDLEY 1977; REID 1997), *T. lavalii* Pine, 1993 was recently described from the Amazon basin of northeastern Peru (but see also CZAPLEWSKI 1996), and *T. discifera* (LICHTENSTEIN and PETERS, 1855) is found mainly in South America, except for two records from Nicaragua and Panama (WILSON 1978; REID 1997). The sympatric occurrence of *T. tricolor* and *T. discifera* in Costa Rica was suggested by RODRÍGUEZ (1993), however, R. M. TIMM (pers. comm.) examined the specimen previously considered *T. discifera* in the Museo de Zoología, Universidad de Costa Rica (UCR-1548) and considered it to be a juvenile *Thyroptera tricolor* (TIMM and LAVAL 1998). In the present study, we report on a new specimen of *T. discifera* recently collected in Costa Rica.

### **Material and methods**

A single adult *Thyroptera discifera* was caught in the lowest shelf of a mistnet set over a trail at 23.00 h on 21 April 1998 at the La Selva Biological Station on the Atlantic slope of Costa Rica, Heredia Province. The capture location lies in a ca. 40-year-old secondary forest in an abandoned cacao plantation in the vicinity of primary rainforest and ca. 80 m distant from the Puerto Viejo river. Morphological measurements were taken following HANDLEY (1988). Fecal pellets were collected and

preserved in 70% ethanol. The wing proportions, aspect ratio index (ARI) and wing tip index (WTI) were calculated following FINDLEY et al. (1972) with the following formulas:

$$\text{ARI} = \frac{(\text{FA} + \text{F3})}{\text{F5}}; \quad \text{WTI} = \frac{\text{F3}}{\text{FA}}$$

FA: length of forearm (mm), F3: length of third finger (mm), F5: length of fifth finger (mm)

Echolocation calls were recorded with a storage bat detector (Petterson D980) from the flying bat in a large flight cage (8 m×4 m×4 m) with walls of plastic mesh. Calls were reduced in speed to one tenth of original speed and stored on a tape recorder (Sony WM-D6C). Sound analysis was performed using SASLab Pro software Ver. 3.2 (Avisoft Co., Berlin, Germany).

## Results

### Capture location and observations

Although we previously found *Thyroptera tricolor* roosting during the day within the rolled new leaves of *Heliconia* spp. at La Selva, this animal (Fig. 1) was the first mistnet-capture of the genus for more than 2 years of frequent mistnetting at the station. The lack of distinctly white underparts and a uropatagium sparsely covered with long hairs alerted us initially that the individual was not the commonly seen *T. tricolor*; therefore the animal was collected. The authors' identification of the animal as *T. discifera* was later confirmed by R. K. LAVAL, Monteverde and R. M. TIMM, University of Kansas (pers. comm.). Our specimen, which is deposited in the Museo de Zoología, Universidad de Costa Rica, represents the first record of *T. discifera* in Costa Rica.

While in a cloth bag the bat was constantly moving; however, it calmed down considerably when we put it in a glass tube where it could attach to the walls with its suction disks. The animal was able to fly in a slow, highly maneuverable flight pattern, within a small cage (1 m×1 m×1 m).

### Description

The specimen is an adult male with well-developed testis (testis size 4×3 mm). The fur is pale brown and rather long and woolly in appearance, especially at the posterior dorsum. The ventral fur is only slightly lighter in color than the dorsal and, in contrast to *T. tricolor*, not yellow or white. Suction cups on the base of the thumbs are slightly oval (major and minor diameters 3.5 and 2.5 mm, respectively); suction cups on the hind feet are smaller and round (diameter 2 mm). The dorsal side of the uropatagium is sparsely covered with long hairs. The tail extends 2 mm past the uropatagium. The calcar has one distinct proximal cartilaginous projection and more distally a minute second one which is less than one fourth of the size of the first projection. Length of the tibia is 15 mm, and forearm length is 31.1 mm. Length of 5<sup>th</sup> finger is 40 mm and of 3<sup>rd</sup> finger is 52 mm. Based on these data the Aspect Ratio Index of the animal was 2.08 and the Wing Tip Index was 1.67. Body mass at time of capture was 3.1 g. Total length is 65 mm, tail vertebrae 28 mm, ear 13.5 mm, and hindfoot 6.0 mm.

### Diet

We obtained four fecal pellets from the animal, each containing scales from small Lepidoptera. We also found fragments of two different sized chelicerae and combed tarsal claws, indicating that the animal had been feeding on several spiders before capture.



**Fig. 1.** New World disk-winged bat *Thyroptera discifera* caught at La Selva, Costa Rica, in April 1998. Note sparse, long hairs at uropatagium.

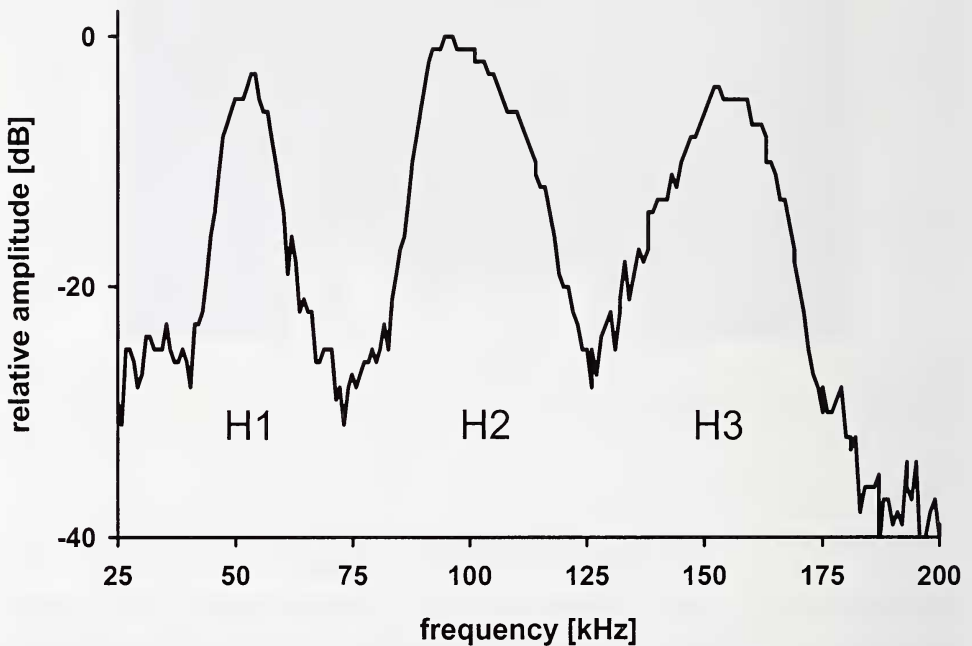
### Social calls and echolocation behavior

The animal frequently emitted audible sounds when disturbed. These sounds consisted of one or two “chip” notes, which closely resembled sounds made by glass frogs (*Centrolenella* sp.). The sounds were whistling, clear tones that did not sound metallic or harsh.

Echolocation calls were very low in intensity and could only be heard while the bat was flying towards the observer and was within 2–3 m of the bat detector’s microphone. The sonagram (Fig. 2) shows broad-banded frequency modulated calls with single calls consisting of the fundamental frequency plus two upper harmonics (H1, H2, H3). Amplitude peaks of the harmonics were ca. 50, 100, and 150 kHz, respectively (Fig. 3). Average duration of calls was 0.90 ms ( $SD \pm 0.23$  ms,  $n = 52$ ). Calls were emitted in series of 3–19 calls with an average of 6.2 calls per series ( $SD \pm 3.4$ ,  $n = 70$ ). The intervals between calls within a series were remarkably constant ( $\bar{x} = 10.7 \pm 1.7$  ms,  $n = 138$ ).



**Fig. 2.** Sonagram of echolocation calls from *Thyroptera discifera*. The short FM sweeps consist of the fundamental frequency (H1) and two harmonics (H2, H3). (Sequence was edited: call intervals have been shortened.)



**Fig. 3.** Average power spectrogram from echolocation calls from *Thyroptera discifera* ( $n = 9$  calls) showing three harmonics (H1, H2, H3).

### Discussion

Assuming that the echolocation behavior of the animal was not too greatly affected by the situation of the bat flying in the large flight cage, the call structure closely resembled that from “whispering bats”, e.g. phyllostomids, and gleaning insectivorous species, e.g.

the vespertilionid genus *Plecotus*. Wing beat and emission of echolocation pulses are generally synchronized in bats (HEBLICH 1986; SCHNITZLER 1971). Wingbeat frequencies in bats range between 8 and 15 beats per second (NEUWEILER 1993) or ca. 125 to 66 msec per wingbeat cycle. The intervals between calls of *T. discifera* were much shorter (10.7 ms), indicating that the animal emitted not only one but several calls per wingbeat, which is known from gleaning bats (ARITA and FENTON 1997).

The information concerning diet obtained for the animal is consistent with data from the literature for the genus (WHITAKER and FINDLEY 1980) in so far that Lepidoptera are consumed. The presence of spider fragments indicates that the animal used the maneuverable flight we observed in the small flight cage for collecting arthropods from the vegetation. Spider fragments were recently also found in feces of *T. discifera* from the Amazon (RODRIGUEZ-HERRERA et al. 1999) and of *T. tricolor* from Costa Rica (DECHMANN pers. comm.).

Compared with other insectivorous bats from La Selva (HELLER and VOLLETH 1995) *T. discifera* has both a low ARI and WTI. These wing proportions indicate good maneuverability in flight (FINDLEY et al. 1972), which is mandatory for an animal gleaning insects from the vegetation. Our observations on the animal's capability to fly within the restricted space of the 1 m<sup>3</sup> flightcage support these theoretical considerations.

The low intensity echolocation calls of the New World disk-winged bat *Thyroptera discifera* are in sharp contrast to the loud calls observed for the Old World sucker-footed bats (Fam. Myzopodidae) of the genus *Myzopoda* (GÖPFERT and WASSERTHAL 1995). Although both families share distinct morphological adaptations that enable them to roost clinging to leaf surfaces, their echolocation characteristics are very different, indicating a different diet and/or foraging behavior.

In conclusion our observations on wing morphology and flight behavior and the analysis of echolocation calls and diet suggest that *Thyroptera discifera* hunt in highly cluttered habitats and are capable of gleaning behavior. The slow and maneuverable flight might be responsible, at least in part, for the lack of mistnet captures within the genus.

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R. K. LAVAL (Monteverde, Costa Rica) and R. M. TIMM (University of Kansas) kindly helped with the identification of the specimen. Our thanks to J. GUEVARA SEQUEIRA (MINAE) for assisting in legal requirements. D. CORDES identified the spider fragments from the fecal sample. F. MATT, M. HOLDERIED, K.-G. HELLER, and O. v. HELVERSEN (University of Erlangen) provided helpful advice on echolocation analysis and valuable comments on the manuscript. Financial support was provided by the DFG (Wa 158/4-4).

## Zusammenfassung

### *Thyroptera discifera* (Chiroptera: Thyropteridae): Ein neuer Nachweis für Costa Rica und Beobachtungen zur Echoortung

Wir berichten vom ersten Fund der seltenen neotropischen Haftscheibenfledermaus *Thyroptera discifera* (Chiroptera: Thyropteridae) in Costa Rica und stellen Beobachtungen zu Morphologie und Echoortungsverhalten der Art vor. Im Kot fanden sich Fragmente von Schmetterlingen und von Spinnen. Die Echoortungsrufe waren extrem kurze und leise frequenzmodulierte Laute mit mehreren harmonischen Obertönen. Verhaltensbeobachtungen und Charakteristika der Echoortungslaute sowie die Ergebnisse der Nahrungsanalyse deuten daraufhin, daß *T. discifera* die Fähigkeit zum Ablesen ihrer Beute von Blättern („gleaning“) besitzt.

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